Homework 3

Due: 8 March 2021

Problem 3.1

Write up a a lab report with the raw results (in nanoseconds per operation) you gathered in the lab. Use your preferred spreadsheet or graphing software to print a series of XY charts (scatter plots) illustrating how the increasing input size affects the performance for each operation (add-end, access-middle, remove-first) for each data type (vector, deque, map). However many times you have run the program for a particular data point (presumably, at least once per group member, although it can be more), plot *all* the results—this will give the charts a bit more statistical power and help to average out any outliers.

Note that to *illustrate* a comparison like that, you will have to put multiple data lines in the same chart; but if you put all nine lines in a single graph, the scale will be such that it obscures the story the data would otherwise be telling. So you have to think about which lines should go together in order to *illustrate* your conclusions.

Once you've got the charts, write out in words an analysis of what you can learn about these data structures just from how they react to different sizes of data. Use the terminology of algorithmic analysis and big-O notation, as best you can, to express your analysis.

Problem 3.2

Each of the following pairs of expressions represents the total number of operations required for two competing versions of an algorithm. In each case, give the big-O representation for the expression, and indicate at what value of n the "better in the long run" algorithm of the pair starts having better performance than the other one. The expression $\lg n$ is an abbreviation for $\log_2 n$.

a. $3n^2 + 2n + 15$
   $20n + 18$

b. $12n + 15\lceil \lg n \rceil + 2$
   $4n\lceil \lg n \rceil + 5$